

## Research

## Invaders Have Fewer Parasites, Giving Them a Competitive Edge Over Native Animals and Plants

By Gloria Maender

Invasive species—second only to habitat destruction in threatening biodiversity—have far fewer parasites and less illness to contend with than their native competitors, according to two new studies in the February 6 issue of the journal *Nature*. In such superpests as the European green crab, this escape from parasites means that the crab gains an unfair advantage over its competition.

“Invasive species end up with about half the parasites, or diseases, they had at home,” said **Kevin Lafferty**, a U.S. Geological Survey (USGS) marine ecologist at the Western Ecological Research Center’s Channel Islands Field Station in Santa Barbara, CA. This conclusion was among the findings of **Lafferty** and his colleagues **Mark Torchin**, **Armand Kuris**, and **Valerie McKenzie** of the Marine Science Institute at the University of California, Santa Barbara, and **Andrew Dobson** of the Department of Ecology and Evolutionary Biology at Princeton University.

“On average, an animal has 16 parasites at home but brings fewer than three of these to new areas that it invades,” said **Torchin**, the lead scientist of this study. “In the new region, parasites are not well matched to novel hosts, and only about four parasites will successfully attack an invading species.”

Parasites are so pervasive that parasitism is the most common lifestyle on Earth, according to **Lafferty**, whose studies of parasites have been featured in previous *Sound Waves* articles (April 2002, August 2002).

Many parasites don’t just make animals sick, they may castrate them, change their behavior, or even kill them. By leaving parasites behind, introduced species may have an advantage over less fit native competitors, which remain fettered to their



*European green crab underside, showing knoblike parasitic barnacle. Photograph by Todd Huspeni, University of California, Santa Barbara.*

own full complement of parasites.

In **Lafferty’s** view, “Parasites are to invasive species what kryptonite is to Superman. Back on planet Krypton, kryptonite was a regulator, keeping Superman ordinary. Freed from kryptonite on Earth, he gained superpowers. But unlike Superman, who used his power for good deeds, invasive species can be devastating.”

The scientists analyzed parasite studies of 26 invasive animal species, from snails to rats, comparing them in natural habitats and invaded habitats. Among them was the European green crab, which **Torchin** and colleagues traveled the world to study.

The scientists found that in Europe, the green crab’s native home, parasitic barnacles castrated the crabs. Where the barnacles were common, the crabs were small and rare. Conversely, the scientists found

that crabs were big and abundant in areas where barnacles were uncommon.

Green crabs have been introduced around the world, to the west and east coasts of the United States, South Africa, Australia, Tasmania, and Japan, but barnacles have never made the transfer with them. In these introduced areas, green crabs are commonly devastating pests that decimate native shellfish.

The same pattern holds true for invasive plants, according to **Charles Mitchell** and **Alison Power** of Cornell University, in a separate study. They found that the introduced plants most likely to become weeds are those that have left behind the most pathogens.

Additionally, the two studies documented that the parasites lost by invasive spe-

*(Parasites continued on page 2)*

### Sound Waves

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### Submission Guidelines

**Deadline:** The deadline for news items and publication lists for the April 2003 issue of *Sound Waves* is Thursday, March 13.

**Publications:** When new publications or products are released, please notify the editor with a full reference and a bulleted summary or description.

**Images:** Please submit all images at publication size (column, 2-column, or page width). Resolution of 200 to 300 dpi (dots per inch) is best. Adobe Illustrator® files or EPS files work well with vector files (such as graphs or diagrams). TIFF and JPEG files work well with raster files (photographs or rasterized vector files).

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### U.S. Geological Survey Earth Science Information Sources:

Need to find natural-science data or information? Visit the USGS Frequently Asked Questions (FAQ's) at URL <http://ask.usgs.gov/faqs.html>

Can't find the answer to your question on the Web? Call **1-888-ASK-USGS**

Want to e-mail your question to the USGS? Send it to this address: [ask@usgs.gov](mailto:ask@usgs.gov)

### Research, continued



*European green crabs in their natural habitat are smaller (left) than those in invaded habitat (right). Photograph by Jeff Goddard, University of California, Santa Barbara.*

*(Parasites continued from page 1)*

cies are also their widespread “Achilles’ heel,” a weakness that can be intentionally turned against them.

In some cases, according to the scientists, bringing in parasites from a pest’s native range can hinder superpests. The benefits to this organic form of pest control are sustainability, low cost, and re-

duced dependency on pesticides; but the scientists cautioned that biological control of pests is risky if the parasites are not specific to the target pest.

“Suitable biocontrol agents should be harmless to native species, just as kryptonite is harmless to Earthlings,” said **Lafferty**. ☼

## Lake Mead Work Continues, with Presentations and Sampling

**By Dave Twichell**

U.S. Geological Survey (USGS) scientist **Dave Twichell** presented results from research on sediment transport in Lake Mead to the Southern Nevada Water Authority on December 19 and to managers in the National Park Service on January 7.

The Southern Nevada Water Authority, the agency that oversees water quality and water usage for the State, was keenly interested in the results from our coring work that indicate sand has been transported at least 8 km into the lake from Las Vegas Wash. This wash, a small stream by East Coast standards, drains the Las Vegas metropolitan area. The Park Service man-

agers were interested in our geologic mapping as an aid to modifying and moving recreational facilities on the lake.

A mid-January weekend was spent in the field collecting samples from the delta where the Colorado River enters Lake Mead. January’s lake level—57 ft lower than when we completed geophysical mapping in April 2001—provided an unusual opportunity to walk over, photograph, and directly sample what 2 years ago could be viewed only in the geophysical records. A 2-mi walk through the desert in 70°F weather (while my USGS

*(Lake Mead continued on page 3)*



## Research, continued

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colleagues in Woods Hole, MA, were putting up with 10°F weather), followed by a 0.5-mi walk across desiccated deltaic deposits, led to some spectacular exposures along the bank of the Colorado River. The west edge of the Colorado Plateau provided a truly extraordinary backdrop to the field area. **Scupper**, the ever-enthusiastic dog, gamely did the entire walk until she faced the last 100 yd, at which point she lay down and, with tail wagging, refused to go another step. So, at the end of the day, not only did I have to carry all the samples, but I also had to carry one of my field assistants! ❁

*The author's dog, **Scupper**, contemplates a series of slump scarps along the bank of the Colorado River.*



## Outreach

### Christmas-Season Dolphin Rescue

By Dennis Krohn

On January 23, **Molly McLaughlin** from the U.S. Geological Survey (USGS)'s Center for Coastal and Watershed Studies in St. Petersburg, FL, spoke to second-graders at McMullen-Booth Elementary School in Clearwater, FL, about the December rescue of two stranded dolphins in Tampa Bay. The children had expressed an interest in hearing about the mother and son dolphins, who beached in 8-inch-deep waters on the afternoon of December 23. The dolphins were discovered by two fishermen and taken to



***Molly McLaughlin** answers questions from second-graders about two dolphins rescued over the Christmas holiday and her experience in helping care for them.*

the Florida Aquarium in Tampa. **Molly** received a call around 10 p.m. that evening from a member of the Marine Mammal Rescue Team looking for volunteers to help care for the dolphins. She arrived at the aquarium at 11 p.m. and worked with the rescue team through the night until midmorning on Christmas Eve. **Molly** was on one of the first teams to care for the dolphins, who had a severe case of sunburn from being exposed to the air.

On Christmas Eve, the dolphins were transferred across the bay to the Clearwater Marine Aquarium, where they were named **Noelle** and baby **Nicholas**, in honor of the Christmas season. **Noelle** died on December 27, from infections connected to her burns, but **Nicholas** continues to recover. **Dennis Kellenberger**, executive director of the aquarium, estimated that **Nicholas** still has at least 6 months of healing to go, given the damage caused by his third-degree sunburn. By late February, **Nicholas** was no longer quarantined; he was eating solid food, cooperating with his caregivers, and starting to play. Periodic updates about his condition are available at URL <http://www.cmaqarium.org/Christmas%20dolphins.htm>. ❁

### London Interns Tour USGS Facility in St. Petersburg, FL

On January 8, **Kim Yates** hosted a group of approximately 20 interns from the University of London for a tour of the U.S. Geological Survey (USGS)'s Center for Coastal and Watershed Studies in St. Petersburg, FL. The students were led by professors **Kate Spencer** and **Sarah James** on a tour of South Florida as part of their program on environmental policy. The students were 5th-year undergraduates majoring in geology, chemistry, biology, geography, and engineering. Unlike the United States, the United Kingdom has a 5-year undergraduate program and a 1-year intensive Master's program. The students take two semesters of focused studies and one semester of project work, and then complete a 10,000-word thesis in 3 weeks. **Kim** organized the tour so that the students had opportunities to interact with scientists working on different aspects of the Tampa Bay Pilot Study. Several of these students are interested in undertaking Master's projects in collaboration with USGS scientists. The students were excited about the work being done by the USGS, and many positive ideas for projects were generated by the tour. The USGS is in the process of pursuing a cooperative agreement with the University of London for a formal student-exchange program. ❁

## Congressional Briefings on Gas Hydrates

By Debbie Hutchinson

Three factors have come together to bring gas-hydrate studies into focus at high levels in government:

- the Methane Hydrates Research and Development Act of 2000, signed into law by **President Clinton** in May 2000, which directed the Department of Energy (DOE) to coordinate a program of gas-hydrate research and technology;
- the National Energy Policy, developed by **President Bush** shortly after he took office, which focused on making energy more reliable, affordable, and environmentally sound; and
- the World Trade Center terrorist attacks in September 2001, which prompted many citizens and politicians to evaluate the Nation's reliance on energy resources from the Middle East.

It was therefore no surprise when U.S. Geological Survey (USGS) scientist **Debbie Hutchinson** received a call from a

colleague at the National Oceanic and Atmospheric Administration (NOAA), asking her to participate in a briefing for several Senate staffers who wanted to learn about gas hydrates.

Despite the uncertainty in the budget in early January, **Debbie** participated in two briefings for Congress on January 16, 2003. The first briefing was to the Senate staffers who initially requested it: **Myron Nordquist, Chris Lee, and Eric Bovim**, all representing **Senator Conrad Burns'** (Montana) office. Coincidentally, **Senator Burns** is Chairman of the Senate Appropriations Subcommittee for the Department of the Interior, making a good impression of USGS work imperative. The briefing was given by **Debbie**, covering an introduction to and geologic aspects of gas hydrates; **Barbara Moore** (director of NOAA's Undersea Research Program), covering the biological and climate-change aspects of gas hydrates; and **Edith Allison** (DOE, Fossil Fuels),

covering legislative mandates and inter-agency coordination.

The second briefing was a repeat of the first, but for staffers on the House Energy Resources committee. **Tim West**, USGS Congressional Liaison, and **Frances Pierce**, Acting Associate Program Coordinator for the USGS' Energy Resources Program, also participated.

One potential sign of the success of the briefings was their length. We were scheduled for an hour for each briefing and forewarned by others that these rarely go the full length because of the hectic schedules of the staffers. As it turned out, both briefings were lively with questions and discussions and went for a full 90 minutes. Responding to followup inquiries included developing two posters for **Senator Burns'** staff, one showing the detailed distribution of gas-hydrate resources around the United States, and another composed of maps showing various aspects of global gas-hydrate resources.✿

## Scientist Speaks to Pilots About Volcanic Ash and Aviation Safety

**Dennis Krohn** from the U.S. Geological Survey (USGS)'s Center for Coastal and Watershed Studies in St. Petersburg, FL, spoke to the Florida Suncoast chapter of the Ninety-Nines club on February 8. The Ninety-Nines, Inc., are an international organization of female pilots founded in 1929 to promote women in aviation. **Dennis** met their program

chairman, **Sofia Payton**, at the Girl Scouts 90th-anniversary celebration (see article in December 2002/January 2003 *Sound Waves*). **Sofia** liked **Dennis'** research topic on volcanic ash and aviation safety and asked him to be the speaker for the Ninety-Nines' February meeting at Albert Whitted Airport in St. Petersburg, FL. The women found the topic so interesting and important that they are asking him back to talk to their aviation-safety committee.✿



**Dennis Krohn** (far right) standing next to members of the Ninety-Nines, Inc., an association of female pilots, after his lecture on volcanic ash and aviation safety.

## Science Mentoring

By Sarah Kelsey

Members of the Woods Hole science community had the opportunity to volunteer at the Lawrence School in Falmouth, MA, through the Woods Hole Science and Technology Education Partnership (WHSTEP). Scientists, including **Sarah Kelsey** and **Kate Visser** of the U.S. Geological Survey (USGS)'s Woods Hole Field Center (WHFC), guided 7th- and 8th-grade science students in the early stages of planning their science projects to help them develop their ideas. According to **Sarah**, the students were quite enthusiastic, although some of them needed a little more coaxing than others. There were many different and interesting project ideas. Participants had a lot of fun and will return to offer their mentoring services again. If anyone from WHFC would like more information or would like to volunteer, please contact **Molly Cornell** at [mcornell@cape.com](mailto:mcornell@cape.com).✿



## Coastal-Vulnerability Studies Presented at Organization of American States Meeting in Barbados

By Erika Hammar-Klose

**Rob Thieler** and **Erika Hammar-Klose** of the U.S. Geological Survey (USGS)'s Woods Hole Field Center were invited by the Organization of American States (OAS) to present a method for assessing the relative vulnerability of coasts to sea-level rise at a recent meeting in the Caribbean. They attended the Vulnerability Assessment Techniques (VAT) III Workshop, held in St. Michael, Barbados, on December 4 and 5, 2002, where they discussed their research using the coastal-vulnerability index (CVI).

The USGS' Office of International Programs provided support for **Erika Hammar-Klose** to present the results of USGS CVI studies at the workshop and foster increased collaboration between the USGS and OAS. A group of coastal scientists, regional planners, coastal-zone managers, engineers, and other interested parties met at the workshop to discuss "Coastal Hazards Vulnerability Assessment Methodologies and Their Applications." The conference was organized by

the OAS' Unit for Sustainable Development and Environment, the Caribbean Development Bank (CDB), and the National Oceanic and Atmospheric Administration (NOAA)'s Coastal Services Center. The goal of the meeting was to increase the awareness and application of vulnerability assessments in the development-planning process at local, regional, and national levels and to further develop a network of hazard-management professionals in the Caribbean region and Latin America. Participants came from the United States, the Caribbean, Central America, and South America.

The CVI provides a means to assess the relative vulnerability of the coast to future sea-level rise. This methodology has been applied to the U.S. Atlantic, Pacific, and Gulf of Mexico coasts (see URL <http://woodshole.er.usgs.gov/project-pages/cvi/>). The CVI methodology was well received by workshop participants, and much discussion ensued as to how a similar study could be car-

ried out and applied in other countries. Currently, **Rob Thieler**, **Jeff Williams**, and **Elizabeth Pendleton** of the USGS' Woods Hole Field Center are applying the CVI to several coastal national parks through a cooperative program with the National Park Service (see URL <http://woodshole.er.usgs.gov/project-pages/nps-cvi/>).

Additional presentations at VAT III were given on techniques for coastal-, hurricane-, and seismic-hazard assessment, as well as methodologies for multihazard evaluation. A series of breakout sessions were held to discuss the strengths and weaknesses of the vulnerability-assessment techniques presented, as well as future research needs, strategies, and opportunities to broaden the use of vulnerability-assessment information. For more information on the VAT III workshop, see URL [http://www.csc.noaa.gov/vata/vat\\_3.html](http://www.csc.noaa.gov/vata/vat_3.html).

## USGS Scientists Meet to Explore the Role of Lidar Data and Technology in USGS Programs

By Tonya Clayton

More than 50 scientists from all four disciplines of the U.S. Geological Survey (USGS) participated in a USGS Lidar Workshop held last November in St. Petersburg, FL. Lidar (light detection and ranging) is analogous to radar (radio detection and ranging), except that lidar uses light waves emitted by a laser (rather than radio waves) to gather data. In its simplest form, lidar is used to determine the distance from the laser to a given object. More sophisticated lidar systems can provide such information as sea-surface roughness, wind velocity, or vegetation density.

Sponsored by the USGS' Land Remote Sensing Program and convened by **Bryan Bailey** (Land Remote Sensing Program), **John Brock** (Coastal and Marine Geology

Program), **Pat Chavez** (Flagstaff Field Center), **Ralph Haugerud** (National Cooperative Geologic Mapping Program), and **Dean Gesch** (EROS Data Center), the workshop aimed to identify and discuss a wide range of topics and issues related to USGS applications of lidar data and technology. Primary goals of the workshop were to facilitate interaction and enlightenment of USGS scientists and managers with respect to lidar data and technology and to help them derive maximum and cost-effective benefit from the application of lidar data in their work.

The workshop was characterized by an interactive format, with participants first sharing their individual interests in and ex-

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**Bruce Molnia** (Geology Discipline, Reston, VA) and **Theresa Olsen** (Water Resources Discipline, Tacoma, WA) enjoy lidar "shop talk" at the evening poster session.

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perience with lidar data and technology. In subsequent plenary and breakout sessions, six issues that influence the efficient and effective use of lidar data and technology were addressed:

- Current and future lidar technologies,
- Lidar applications within USGS science disciplines,
- Calibration and accuracy assessment,
- Tools for processing and evaluating lidar data sets,
- Lidar data management, and
- Commercial and contracting issues.

A popular feature of the workshop was the evening poster session, which created

an opportunity for informal presentation and discussion of ongoing lidar-related work.

Reflecting a longstanding interest in lidar, scientists from the coastal arena constituted a strong presence at the workshop. Presenters from coastal field centers included **John Brock** ("Temporal Waveform Resolving Lidar" and "Aircraft Position and Attitude Determination"), **Tonya Clayton** ("Integrated Lidar and Hyperspectral Scanning"), and **Amar Nayegandhi** ("Tools for Processing and Evaluating Lidar Data Sets: USGS/St. Petersburg Lidar Processing Software").

Participants from the Center for Coastal and Watershed Studies (St. Petersburg, FL) included **Melanie Harris, Karen Morgan, Eric Nelson, Meg Palmsten, Ellen Raabe, Abby Sallenger,** and **Hilary Stockdon**. Registrants from the Pacific Science Center (Santa Cruz, CA) included **Ann Gibbs, Cheryl Hapke, Mimi D'Iorio,** and graduate student **Dave Reid**.

A volunteer committee that includes **Ellen** and **Karen** is compiling a workshop report. To receive a copy of the report when it is complete, please e-mail a request to [rsnotes@usgs.gov](mailto:rsnotes@usgs.gov).

## International Deep-Sea Corals Workshop

By **Kathy Scanlon**

U.S. Geological Survey (USGS) scientist **Kathy Scanlon** participated in the International Deep-Sea Corals Workshop in Galway, Ireland, on January 16 and 17. The workshop, which was jointly sponsored by the U.S. National Oceanic and Atmospheric Administration (NOAA) and the Irish Marine Institute, brought together about 25 deep-water-coral researchers from the United States, Canada, Ireland, Norway, Sweden, England, Belgium, and Germany to develop plans for future research and international collaboration.

Deep-water corals (also called cold-water corals, deep-sea corals, cool corals, and azooxanthellate corals) occur predominantly in water depths between 100 and 1,000 m, below the photic zone.

(The more familiar, zooxanthellate corals thrive in the shallowest parts of the photic zone—generally less than 30 m deep—where there is ample sunlight for photosynthesis by their symbiotic zooxanthellae.) In some places, deep-water corals form spectacular coral mounds and reefs. They have been reported in U.S. waters off Alaska, in the Gulf of Mexico, off eastern Florida, and off New England but have been little studied. Recent research, much of it in Norway, Sweden, Ireland, and Canada, has shown that deep-water corals are important as essential fish habitat, biodiversity hotspots, and climate-change indicators and as potential sources of pharmaceutical compounds. Because they are long-lived, slow-growing, and fragile, they

are particularly vulnerable to impacts from such human activities as trawling and oil and gas development.

Three major themes were discussed during the workshop:

1. Mapping and characterizing deep-water corals and their habitats
2. Biology of deep-water-coral ecosystems
3. Paleoclimate research

Preliminary plans were made for several collaborative international projects, including a major multinational, circum-North Atlantic series of cruises designed to locate and study deep-water-coral habitats and bring attention to their importance to fishery issues, biodiversity, and ecosystem function.

## Winter Science Planning by the Sea

By **John Bratton**

The U.S. Geological Survey (USGS)'s Northeastern Coastal Ecosystems and Resources Workshop, a large science-planning event, was held on January 7 and 8 in Narragansett, RI. Approximately 75 people participated, including representatives from all USGS disciplines (geography, biology, water, and geology), regional executives, program coordinators, and team chief scientists. Representatives also attended from outside

agencies and organizations, including the Woods Hole Oceanographic Institution (WHOI), the University of Rhode Island (URI), the National Oceanic and Atmospheric Administration (NOAA)'s National Marine Fisheries Service (NMFS), the National Park Service (NPS), the U.S. Fish and Wildlife Service (FWS), the U.S. Environmental Protection Agency (EPA), the Federal Emergency Management Agency (FEMA), the U.S. Army

Corps of Engineers (USACE), Battelle, and the Massachusetts Institute of Technology Sea Grant program (MIT Sea Grant). **Peter August** served as host for the meeting, which was held at the scenic University of Rhode Island Coastal Institute facility overlooking Narragansett Bay.

Daytime sessions focused on the development of integrated approaches to

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## Meetings, continued

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addressing overarching coastal themes for the Northeast region, and an evening poster session and cabaret gave participants a chance to share their regional research. The workshop participants provided input to the development of an integrated science plan that uses existing USGS capabilities and identifies those that are needed from outside collaborators.

The steering committee selected three “big issues” as the science framework for the workshop. These issues had been identified as critical scientific needs in several previous regional workshops. Addressed within each issue were the primary threats to coastal ecosystems and resources, the stressors arising from

those threats, and consequent ecological responses. The issues were:

- Fluxes (water, nutrient, sediment, and contaminants),
- Coastal hazards (climate change and sea-level rise, shoreline change), and
- Urbanization (and related habitat change).

The meeting kicked off with inspiring presentations by the following invited speakers: **John Farrington**, Vice President for Academic Programs and Dean of WHOI; **Scott W. Nixon**, Professor of Oceanography at URI's Bay Campus; and **Arthur Lerner-Lam**, Associate Director for Seismology at the Lamont-Doherty Earth Observatory. After the presentations,

participants broke into rotating discussion groups to address the three “big issues.” Breakout-session facilitators then summarized results for the entire group and gave these summaries to a writing team. The writing team will develop a 10-page science plan by May, summarizing the meeting and identifying specific priorities for future coastal science in the region.

Special thanks go to facilitator **Susan Russell-Robinson**, host **Peter August**, the breakout-session facilitators, the organizing committee, and the entertainers of the evening, Estuaries Cabaret. Additional information about the meeting can be found at URL <http://me.water.usgs.gov/coastal/>. ❁

## Awards

### Gene Shinn Wins 2002 Shoemaker Award for Distinguished Achievement in Communications

The 2002 Shoemaker Award for Distinguished Achievement in Communications has been awarded to U.S. Geological Survey (USGS) scientist **Gene Shinn** (St. Petersburg, FL). Below is the text of the message in which USGS Director **Chip Groat** informed **Gene** that he had won the award:

“Congratulations, **Gene Shinn**! You have been selected to receive the 2002 Eugene M. Shoemaker Award for Distinguished Achievement in Communications. This award is given periodically to honor a U.S. Geological Survey (USGS) employee or private citizen who combines outstanding scientific ability with great skill in presenting complex scientific concepts to many different audiences. This lifetime-achievement award honors your standing in your professional field and your skill and enthusiasm for conveying science in multiple media. The first winner of this award was **Gene Shoemaker** in 1998 for his landmark contributions to the geology of the Earth, its Moon, and the Solar System, and his enthusiasm in educating the public and inspiring young students to enter the science field. You are the fourth recipient of this award since its inception.

“I know you are recognized nationally and internationally for your outstanding

career in the field of carbonate geology, particularly your work on the effects of African dust on reef ecosystem and organizational health. But you are known as well for your skills as a communicator in presenting scientific results in words and graphics that captivate audiences of all types. Your keen sense of audience needs is key to effectively communicating complex and revolutionary scientific theories to a wide audience, ranging from scientific to nontechnical groups, including Federal agencies, private-sector groups, and the media. You have repeatedly been recognized by the scientific community for your work, appeared in the media as the USGS expert in your field, produced numerous videos and training films for use worldwide, and provided endless research and studies on an array of scientific topics. You epitomize the spirit of the Shoemaker Award for Distinguished Achievement.

“I join with all employees in commending you for your efforts in communicating USGS science and its impact on a changing world. Thank you for a job well done! Formal presentation of this year's award will be held at the annual awards convocation in each regional center in spring 2003.” ❁



**Gene Shinn** uses his famous “flushable toilet” model to demonstrate how sewage flushed or injected into shallow disposal wells flows through porous limestone underlying the Florida Keys. Ground-water flow carries the pollutants out to the coral reefs. **Gene** and his colleagues built this model from a coin bank fitted with a water pump and set on a slab of Key Largo Limestone. It has given viewers in a wide range of settings—from school tours and open houses to Congressional briefings—a memorable illustration of limestone permeability.



## 2002 Shoemaker Awards for Communication Product Excellence Won by Coastal and Marine Scientists

Many scientists from the U.S. Geological Survey (USGS)'s Coastal and Marine Geology Program (CMGP) were among the winners of the USGS' 2002 Shoemaker Awards for Communication Product Excellence.

The Shoemaker Awards Competition was established in 1997 in memory of **Eugene Shoemaker** to recognize USGS scientists, writers, editors, and designers who have provided extraordinary examples of communicating and translating complex scientific concepts and discoveries into words and pictures that capture the interest and imagination of the American public. The competition gives two types of awards: the Shoemaker Distinguished Achievement Award, which honors a USGS employee for lifetime achievement (see article "**Gene Shinn Wins 2002 Shoemaker Award for Distinguished Achievement in Communications**," this issue); and the Shoemaker Award for Communication Product Excellence, which honors the makers of information products in several categories.

The 2002 product-excellence award in the print category went to the publication "Beyond the Golden Gate—Oceanography, Geology, Biology, and Environmental Issues in the Gulf of the Farallones" (USGS Circular 1198). This award-winning circular, aimed at a broad audience, uncovers the mystery of ocean waters seaward of San Francisco's Golden Gate, revealing some of the diverse habitats and ecosystems in the region. The publication illustrates the interconnectiveness of geologic, oceanographic, and biologic processes in this region and discusses important environmental issues of contamination and waste disposal. It can be viewed online at URL <http://geopubs.wr.usgs.gov/circular/c1198/>. The awardees include current and former members of CMGP: **Herman Karl** (now with the USGS' Water Resources Discipline), **John Chin**, **Jim Gardner**, **Kaye Kinoshita** (now with the National Oceanic and Atmospheric Administration), **Marlene Noble**, **Stephanie Ross**, **Holly Ryan**, **Bill Schwab**, and **Florence Wong**.

The 2002 product-excellence award in the exhibit category was awarded to a poster entitled "Crater Lake Revealed: Using GIS to Visualize and Analyze the Depths of Crater Lake, Oregon." Among its authors are **Jim Gardner** and **Pete Dartnell**, CMGP scientists who conducted the high-resolution multibeam mapping that "revealed" the floor of Crater Lake in summer 2000 (see article in September 2000 *Sound Waves*). The mapping has shed light on the geology, geomorphology, and geologic history of Crater Lake, and much of the new information is summarized in the award-winning poster. Understanding the history of this volcanic area could be important to understanding future eruptions, which would threaten facilities, residents, and the estimated 500,000 annual visitors to Crater Lake National Park, as well as the major transportation and utility corridor east of the Cascades. In addition to the 2002 Shoemaker award, this poster took third place in the People's Choice competition at the 2001 ESRI User Conference, where it debuted in July 2001 in San Diego. ☼

## John Behrendt and Wylie Poag Elected Fellows of the American Association for the Advancement of Science

**John C. Behrendt** and **C. Wylie Poag**, of the U.S. Geological Survey (USGS)'s Coastal and Marine Geology Program, have been elected Fellows of the American Association for the Advancement of Science (AAAS). **John** was elected for "distinguished contributions to the understanding of crustal controls on the Antarctic Ice Sheet and for efforts to protect and manage Antarctica for the scientific benefit of all nations." **Wylie** was elected for "research leading to the identification of the largest known impact structure in the United States, buried beneath lower Chesapeake Bay and its surrounding peninsulas."

Founded in 1848 to represent all disciplines of science, the AAAS supports sci-

entific exchange and discussion of scientific and societal issues. In 2002, the AAAS added 291 fellows, elected nationally by their peers. The individuals were selected for their efforts to advance science or foster applications that are deemed scientifically or socially distinguished. **John**, **Wylie**, and the other new AAAS fellows were presented with an official certificate and a pin on February 15 at the Fellows Forum held during the 2003 AAAS annual meeting in Denver.

**John** is an emeritus scientist with the USGS stationed in Denver, CO, and funded by the Coastal and Marine Geology Program. He is also a Senior Researcher at the Institute of Arctic and Alpine Research (INSTAAR) at the University of

Colorado, Boulder. **John** has been carrying out geophysical work in Antarctica since 1956. Some of his earliest work in Antarctica is recounted in his book *Innocents on the Ice: A Memoir of Antarctic Exploration, 1957*, published in 1999 by the University Press of Colorado. (See article in February 1999 *Sound Waves*.) **John** published three scientific papers in 2002 through his affiliation with both the USGS and the University of Colorado. In December 2002 and January 2003, he participated in a geophysical cruise in the Ross Sea, Antarctica, at the invitation of researchers from the Scripps Institution of Oceanography and the California Institute of Technology.

(AAAS Fellows continued on page 9)



(AAAS Fellows continued from page 8)

**Wylie** is a research geologist with the USGS in Woods Hole, MA. His 40-year geological career includes experience as a petroleum explorationist, a university professor, and a project coordinator for the National Science Foundation's Deep Sea Drilling Project. His USGS research emphasizes the integration of subsurface geophysical, geological, and paleontological data to reconstruct the stratigraphic framework and depositional history of the Atlantic and Gulf Coast

margins of the United States. He has published more than 250 abstracts, articles, and books on these topics. A recent highlight of his research has been documentation of the largest impact crater in the United States, buried beneath the lower part of Chesapeake Bay and its surrounding peninsulas. As a result of his crater research, **Wylie** received the Thomas Jefferson Medal from the Virginia Museum of Natural History Foundation. The *Baltimore Sun* selected his popular

book on this topic (*Chesapeake Invader: Discovering America's Giant Meteorite Crater*) as one of the best books published in 1999 on the Chesapeake Bay area. The book also earned for **Wylie** the USGS' Eugene M. Shoemaker Award for Communication Product Excellence for the year 2000.

Congratulations, **Wylie** and **John**! ❁

## Canada's Michael J. Keen Medal Awarded to Bill Normark

U.S. Geological Survey (USGS) geologist **Bill Normark** has been awarded the Michael J. Keen medal by the Marine Geosciences Division of the Geological Association of Canada (GAC). The following paragraph summarizes his citation:

"**William (Bill) R. Normark**, a marine geoscientist with the United States Geological Survey (USGS), has excelled in his contributions to several important fields of marine geology but is best known for his contributions to the understanding of submarine fans. He has also played a significant role in the evolution of Canadian marine geology. In the late 1970s and early 1980s, he collaborated with the Geological Survey of Canada (GSC) on research cruises using Canadian vessels and USGS equipment. These joint

projects focused on the evolution of the Laurentian Fan and the late Cenozoic response of the eastern Canadian margin to changes in sea level. During this activity, he also welcomed Canadian graduate students to work at the USGS office in Menlo Park, CA. Through his work on the eastern Canadian margin, he came to know **Mike Keen** and through **Mike** was instrumental in getting the GSC involved in research on modern hydrothermal systems on the Juan de Fuca Ridge. For this work, colleagues from the GSC joined **Bill's** cruises to the Juan de Fuca Ridge, which led to using Canadian equipment (a unique sea-floor rock-coring system) on a ship provided by the USGS."

**Michael J. Keen** (1935–1991) was a prominent Canadian geoscientist. He was

a professor in the Department of Geology at Dalhousie University (Halifax, Nova Scotia, Canada) from 1961 to 1977 and chairman of the department for many of those years. From 1977 to 1991, he was with the GSC Atlantic (at that time called the Atlantic Geoscience Centre) in Dartmouth, Nova Scotia. The Michael J. Keen Medal is normally awarded annually by the Marine Geosciences Division of the GAC to a scientist who has made a significant contribution to the field of marine or lacustrine geoscience. Recipients may be a Canadian or a non-Canadian who has made a contribution in Canada or with a distinctively Canadian flavor. **Bill** will receive his medal at the GAC's annual meeting in Vancouver, British Columbia, in May. ❁



## Farewell to Our Dear Friend, Joe—A Tribute to Joe Newell

By Woods Hole Field Center Staff

**Joseph S. Newell III** passed away on January 19, 2003, at the age of 49. The staff of the U.S. Geological Survey (USGS)'s Woods Hole Field Center join his wife, **Barbara**, and their children, **Elizabeth** and **Christopher**, in mourning the loss of **Joe**. **Joe Newell** was with the USGS in Woods Hole, MA, for 22 years. During that time, he participated in countless cruises, and we depended on him for his knowledge of international and domestic shipping, his large-truck license, his rigging expertise, his role as ship contractor, and, most recently, his position in facilities management. **Joe** was a tremendous asset to the center, and he will be sorely missed by his colleagues, many of whom are honored to have called him a friend.

"**Joe Newell** was well known for his physical strength, but even greater was the strength of his character. He was a person of the utmost integrity, and the most honest man I ever knew. Peace upon him."

—**Robert Barton**

"**Joe** and I had many common threads here at USGS. We both are 49 years of age. We started at the USGS 22 years ago. We arrived one behind the other at 6:30 a.m. to start our workday. We both had to start wearing reading glasses about the same time in order to be able to read the lock combination so we COULD get in to work! Our children are the same ages—both boy and girl. We coached our own children in many youth sports. We laughed at each other's stories concerning their first dates, their first cars, and their first traffic tickets! I know for a fact that **Joe** was a loving, caring, dedicated father and husband by all the conversations we shared throughout our many years as colleagues and simply by his actions. He loved his family dearly and was a dedicated USGS employee.

"When a job needed doing, **Joe** was always there with his myriad of talents to lend an expert hand. Welding, machining, heavy-equipment operation, and that little tidbit of information you just couldn't find anywhere else except from the man who



*Joe Newell, 1953–2003*

had such a broad scope in his knowledge. I'll miss our early-morning stories over coffee and his "I can't believe my kid just did that" parallel humor we both shared as two fathers with not one, but two teenagers living under the same roof! I had the pleasure to work with his son **Christopher** at Pocasset Golf Course last year, and **Joe** can be proud that he and **Barbara** have raised a true gentleman. I consider it an honor to have worked beside both of these men.

"**Joe** will indeed be sorely missed here at MOF [Marine Operations Facility]. May he rest in peace and never have to pick up a welding torch or drive a crane in subzero weather again! That is, unless God really needs his expertise, in which case I'm sure **Joe** would never hesitate. **Joe** was everyone's consummate "Right-Hand Man" here at MOF. We'll miss you, big guy. Rest easy."

—**Dave Nichols**

"Of the two recent field projects I participated in, exactly zero would have had a happy ending without **Joe** finding a way to ship supplies DAYS after the final "Don't Ship Anything After This Deadline Or

It Will Never Make It" day. People here work hard, they have pride in their work, and as a result they can pull off miracles most any day of the week—but saving these field projects was accomplished by **Joe** single-handedly pulling off GIANT miracles, and doing so while we not only WEREN'T helping him but were instead piling more and more together later and later for him to ship. When it was over, he didn't beat us with sticks like he had every right to; he just asked what he could do for us when we showed up at his office door."

—**Bill Waite**

"**Joe**,

What can I say?

I still cannot believe you are gone.

**Joe** was a caring, decent, straight shooting, Big-hearted, talented, genuine, good guy. A caring and loving father and husband. Rock Solid, Steady, Dependable.

Always ready to help.

If you needed to build, fix, weld, machine, truck, ship gear, plan a cruise, or remember the particulars of a ship, deploy or move anything with heavy equipment, Go see **Joe**.

**Joe**, I miss your laugh, how you watched out for me, our talks about our kids.

The world is a lesser place without you."

—**Dann Blackwood**

"**Joe's** contributions to our achievements are not readily visible when one reads the papers and fact sheets, but his work and his spirit permeated it all. He was the cornerstone we could all depend on to help us hold our balance as we all reached out to further USGS science and engineering. He was here for us at home, and he was there for us in the field. When you were on the other coast and forgot an important part, who were you going to call? **Joe Newell**. When customs thought they should keep your shipment, who were you going to call? **Joe Newell**. I will miss his responsiveness in a crisis, his memory, strength, cleverness, and creativity."

—**Marinna Martini**





Unloading in Boston after 1995 cruise on U.S. Coast Guard (USCG) Cutter White Heath.



Handling an airgun on the research vessel Eastward in 1981. Photographer **Dann Blackwood**'s first cruise with **Joe. Greg Miller** on right.



Removing sediment trap on the research vessel Oceanus in 1984.



**Joe** (left) and **Rick Rendigs**

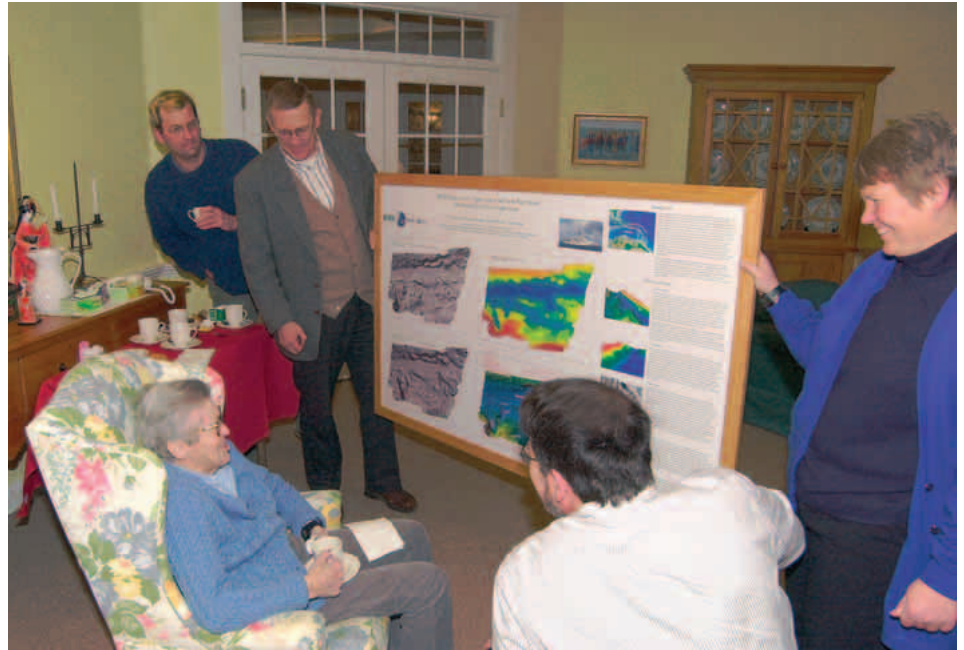
Photographs by **Dann Blackwood**.



## Pioneer in Marine Geophysics Honored

By Uri ten Brink

At more than 8 km (5 mi) deep, the Puerto Rico Trench is the deepest part of the Atlantic Ocean. The trench is located about 130 km (80 mi) north of Puerto Rico and the Virgin Islands, and has been the subject of research by Earth scientists during the past 50 years. Some of the early systematic studies of this challenging environment were conducted by **Elizabeth (Betty) Bunce**, a pioneer in marine geophysics and a Senior Scientist at the Woods Hole Oceanographic Institution (WHOI) until her retirement in 1980. Recent technological advances enable scientists to map the shape of the sea floor at these great depths by using the multibeam-bathymetry technique, which produces detailed morphology and a reflectivity image along a swath several miles wide on either side of the ship's track. The swaths are then "mosaicked," or merged together, to produce a topographic map of the sea floor and detailed shaded-relief and reflectivity images, which are akin to slanted aerial photographs on land. Recent exploration of the trench funded by the National Oceanic and Atmospheric Administration (NOAA)'s Office of Ocean Exploration was conducted by a team from the U.S. Geological Survey (USGS) and the University of New Hampshire (UNH). (See related article in November 2002 *Sound Waves*.) This joint effort has produced for the first time a high-resolution (150-m [500-ft] pixel size) map of part of the



Poster with maps and images of the fault bearing her name is presented to **Elizabeth (Betty) Bunce**. Clockwise from left: **Betty Bunce**, **Dave Du Bois**, **Hartley Hoskins**, **Dicky Allison**, and **Uri ten Brink**. Photograph by **Dann Blackwood**.

floor of the Puerto Rico Trench. The part mapped, a quarter of the total trench area, is about the size of New Jersey.

One of the big discoveries from this mapping effort is a large active tectonic fault system at the bottom of the trench, where the Atlantic and Caribbean tectonic plates slide past each other. This fault system is several hundred miles long, and its activity has produced escarpments and depressions that are several hundreds of feet tall and deep, respectively. The new

fault system was named the Bunce Fault, in honor of **Dr. Bunce**.

A colorful poster with maps and images of the fault bearing her name was presented to **Dr. Bunce** in a small ceremony on January 15 by the leader of the mapping team, **Uri ten Brink**. **Uri** is a research scientist with the USGS in Woods Hole and an Adjunct Scientist at WHOI. The ceremony took place at **Dr. Bunce's** current residence at the Heritage Assisted Living Community in Falmouth, MA. Also present were **Hartley Hoskins**, **Dave Du Bois**, and **Dicky Allison** of WHOI and **Dann Blackwood** of the USGS. The ever sharp and vivacious **Dr. Bunce** shared some of her seagoing stories and her opinion of some of her old colleagues, to the delight of the small crowd. She expressed a keen interest in the present state of knowledge and read a summary of recent models for the formation of this deep trench. Continued mapping of the entire trench area, stretching from north of the Dominican Republic to the Lesser Antilles, is planned for February and March of this year, after which a complete map of the sea floor will be presented to **Dr. Bunce**. ❀



**Betty Bunce** reads a summary of recent models for the formation of the Puerto Rico Trench. **Uri ten Brink** is on the left side of the photograph, and **Hartley Hoskins** on the right. Photograph by **Dann Blackwood**.

## Western Region Coastal and Marine Team Celebrates Careers of Five Retirees

By Florence Wong

Folk remedies for seasickness, surveying in the surf zone, rough seas from pole to pole, and other fond memories seasoned the celebration for recent Western Region Coastal and Marine Geology (CMG) retirees **Keith Kvenvolden**, **Steve Eittreim**, **Diana Collins**, **John Dingler**, and **Monty Hampton**. More than 80 guests gathered to honor the retirees at an event organized by **Anne Gartner** and **Terry Bruns** at Zibibbo restaurant in Palo Alto, CA, on January 23, 2003.

**Keith Kvenvolden**, with the USGS since 1975, has earned international honors and recognition for his investigations of organic geochemistry in settings ranging from sea-floor-spreading zones to continental shelves to beaches to meteorites. **Keith** and his research “dream team” have advanced the knowledge of gas hydrates, identified sources of controversial oil spills, and made the acquaintance of tarballs worldwide. **Bob Rosenbauer** reported that the award **Keith** treasures most is the “do-it-yourself” gas kit (a can of beans and a can of motor oil) given to him by his peers in what was then the Branch of Pacific Marine Geology. **Fran Hostettler** described **Keith’s** dogged pursuit of tarballs right through the middle of a nude beach.

**Steve Eittreim** has investigated continental-margin structure and sedimentation with the USGS since 1975, from the Chukchi Sea in the Arctic to the Wilkes Land margin in Antarctica. In the past 10 years, he has turned his attention to the nearby Monterey Bay National Marine Sanctuary. **Steve** and his collaborators have garnered honors and appreciation from marine and coastal research organizations throughout the Monterey Bay region for investigating and reporting on the geology and oceanographic processes of the sanctuary. Past CMG member **Gary Greene** conceded that **Steve** did bring a new sedimentologic perspective into the neighborhood. **Keith Kvenvolden** admired **Steve’s** ability to master skills to get his own products out, learning new techniques that range from computer illustration to seismic processing and working with geographic information systems (GIS). **Peter Barnes** recalled an early sail



*Retirees (from left to right) **Diana Collins**, **Keith Kvenvolden**, **Steve Eittreim**, **John Dingler**, and **Monty Hampton** at the party in their honor.*

in which he and **Steve** found more excitement than they had anticipated as they learned about San Francisco Bay tidal currents and winter storm waves from a sloop. Now a seasoned West Coast sailor, **Steve** looks forward to enjoying long sails on San Francisco Bay.

**Diana Collins** joined the USGS in 1984 and came to work with the CMG seismic-processing group a couple of years later. **Jon Childs** recalled that field and meeting travel was a tremendous load throughout the mid-1990s: “In the days before the advent of Web-based Omega Travel, and also after, **Diana** did a wonderful job of making sure that we were all well served, both before and after trips.” **Diana** not only helped other team members get to the field, she went there herself in 1991, assisting on a San Francisco Bay cruise to collect seismic reflection and refraction data on faults underlying the region. **Dan Mosier** credits **Diana** for enhancing the work environment by constantly replenishing the supply of treats that the data group makes available to the team.

**John Dingler** has become intimately familiar with the Pacific, Atlantic, and Gulf of Mexico coasts as he has examined

sedimentary processes in a wide range of environments. A graduate of the Scripps Institution of Oceanography, **John** brought a new element to the USGS diving program. Working with **Roberto Anima**, **Ed Clifton**, and other researchers, he used scuba as an important tool to investigate submarine canyons and nearshore processes. **John** was equally at home in the water without his scuba gear: **Monty Hampton** remembered his amazement the first time he and **John** surveyed a beach profile and he saw **John** just about submerged amidst crashing waves as he fearlessly positioned a stadia rod at the seaward end of the survey line. **John** came to work for the USGS in 1974. He and his wife have relocated to Oregon, where she is building up a landscape business and **John** is refurbishing their house and scouting out surfing beaches.

**Monty Hampton** started working with CMG in 1975, in the Gulf Alaska, and pursued his interest in sediment deposition and landslides in Antarctica, in the Pacific Exclusive Economic Zone, on the Palos Verdes margin in Southern California, in Hawaii, and on the central California coast. **Monty’s** reputation as a

*(Retirees continued on page 14)*



(Retirees continued from page 13)

“straight-shooter” preceded **Homa Lee’s** first meeting with him; after getting to know **Monty**, **Homa** decided that **Monty** was the “type section” of that trait. The career-long respect for **Monty’s** opinion and perceptions “rewarded” him with many committee assignments, including a shirt-and-tie term as branch chief. **Rob Kayen**, as **Monty’s** running companion

over hundreds of miles in the Palo Alto hills, remembers **Monty** conscientiously grappling with intractable scientific and administrative problems. **Mike Field** cited a memorable cruise on which **Monty** tried ginger as a natural seasickness remedy, with mixed success. **Monty** looks forward to dividing his retirement time between the West and the East Coast.

Each honoree received a framed photograph of the research vessel *Samuel P. Lee* or the research vessel *Sea Sounder*, an engraved plaque with a USGS benchmark, a gift certificate, and an album of memorabilia. Although each of the retirees has plans to be emeritus or volunteer, their full-time contributions to the Coastal and Marine Geology Program will be missed. ❀

## Manheim Lectures on Trends in Scientific and Technological Innovation

By Frank Manheim

On February 6, U.S. Geological Survey (USGS) scientist **Frank Manheim** presented a seminar at USGS headquarters in Reston, VA, entitled “Science and Technology Effectiveness of Five Nations—Britain, France, Germany, US, and Russia/USSR—from 1800 to the Present, with Special Notes on WWII Science in the United States and Its Impact on the USGS.”

The lecture reflected several years of avocational research by **Frank Manheim** (Reston, VA) with **Chris Barton** (St. Petersburg, FL). The talk reviewed approaches to the measurement of national scientific and technological effectiveness

and reported a new “outcome based” index of national innovation. This type of index is derived from chronological compendia of international discoveries and inventions. The decline in U.S. technology in the 1960s and 1970s is corroborated by other indices, such as patents. A recent update of the curves, which were based on data published in 1988, demonstrates a renewed upswing for the United States beginning in the middle 1980s. Other noteworthy features of the graph are the steep decline in German technology accompanying the Nazi assumption of power in 1932, and a period of enhanced USSR technology stimulated by the reform poli-

cies of Soviet leader **Nikita Khrushchev**. Soviet achievements in this period included the first space flight (Sputnik) in 1957, manned orbit of the Earth, automated lunar landers, and the first commercial jet aviation.

The last part of the talk discussed the impact on the USGS of post-World War II U.S. science-policy developments. This part of the talk was based on new compilations of USGS publications (not including topographic maps) during the period. ❀



Trends in technological innovations in the United States, Germany, and Russia/Soviet Union. (From Paturi, Felix R., 1988, *Chronik der Technik*: Dortmund, Germany, Chronik Verlag, 639 p.)



## New Publication Sheds Light on Earthquake Hazards in the San Francisco Bay Region

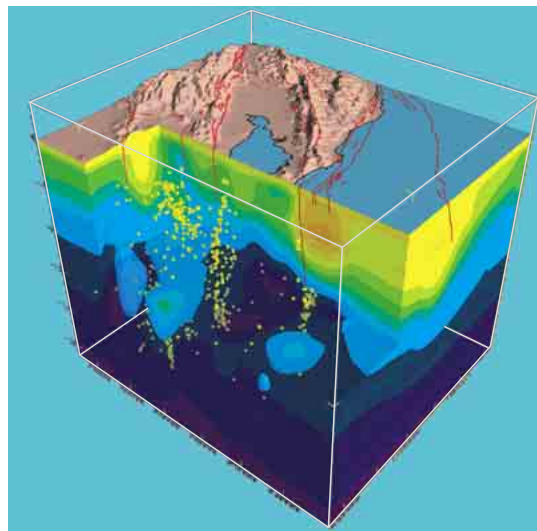
By Helen Gibbons

A new publication from the U.S. Geological Survey (USGS) presents research findings about crustal structure, the locations of earthquake faults, and liquefaction processes in the San Francisco Bay region. Entitled "Crustal Structure of the Coastal and Marine San Francisco Bay Region, California," USGS Professional Paper 1658 is a compilation of eight chapters by a total of 26 authors, with 145 pages and two large maps. It can be viewed online at URL <http://geopubs.wr.usgs.gov/prof-paper/pp1658/>.

Part of the introduction is quoted here:

"The San Francisco Bay region is home to about 7 million people, ranking fifth among population centers in the United States. Most of these people live on the coastal lands along San Francisco Bay, the Sacramento River delta, and the Pacific coast. The region straddles the tectonic boundary between the Pacific and North American Plates and is crossed by several strands of the San Andreas Fault system. These faults, which are stressed by about 4 cm of relative plate motion each year, pose an obvious seismic hazard.

"We have many ways to study earthquake faults. Where faults break the land surface, we may learn valuable information needed for hazard assessment, such as cumulative offset, slip rate, and earthquake history. However, many of the major faults in the region are partly submerged be-



*This illustration from the cover of Professional Paper 1658 shows the upper-crustal seismic-velocity structure of the San Francisco Bay region, as determined from analysis of seismic waves generated by local earthquakes and controlled sources. Warm colors (yellow, orange) indicate slower velocities, cool colors (green, blue, purple) indicate faster velocities. (Differences in seismic velocity typically indicate differences in rock type.) Red lines denote surface fault traces. Lateral changes in seismic velocity correlate with faults at depth and result from rock units of different lithologies being offset by faults. Yellow spheres show locations of some of the earthquake hypocenters used in analysis. View southeastward from near San Francisco.*

neath San Francisco and Monterey Bays. Although this situation poses problems in gathering observational data for hazard assessment, bay-region waterways provide an opportunity to study fault-zone structure by using marine subsurface-imaging techniques, which are easier and cheaper than equivalent studies on land.

"In 1993, the [USGS] launched a 5-year project aimed at unearthing the basic science of the submerged San Andreas strike-slip fault system in the San Francisco Bay region with its many interacting strands. Primary project goals were structural, such as to discover how the San Andreas and Hayward Faults are connected or related at

depth, to learn how the complex of faults in the San Andreas stepover zone on the Golden Gate platform functions, and to locate previously unknown faults. This volume thus contains mostly structural information about the San Francisco Bay region, much of it gathered through exploratory geophysical experiments."

The volume presents a wealth of information derived from various sources, including earthquake tomography, seismic-reflection data, aeromagnetic data, ground-penetrating-radar tomography, microfossil analysis, and study of the historical record of a small tsunami generated by the great 1906 San Francisco earthquake.✻

## Effectiveness of Marine Reserves in Central California

By Gloria Maender

U.S. Geological Survey (USGS) research ecologist **Jim Estes** of the Western Ecological Research Center is among the coauthors of a new report to the Monterey Bay National Marine Sanctuary titled "A Review of the Ecological Effectiveness of Subtidal Marine Reserves in Central California." The report, available online at the Monterey Bay National Marine Sanctuary

Web site (URL <http://bonita.mbnms.nos.noaa.gov/reports/2002/starr120402.html>), is in two portable-document-format (PDF) files. "Part I: Synopsis of Scientific Investigations" provides summaries of several research projects conducted within the three existing marine reserves in the Monterey Bay National Marine Sanctuary and one marine reserve in the Channel Islands Na-

tional Marine Sanctuary, and discusses lessons learned and economic considerations. "Part II: Summary of Existing Marine Reserves in Central California and Their Potential Benefits" compares existing information with predicted benefits of seven potential goals for marine reserves.✻

# Human Influence on Diatom Productivity and Sedimentation in Chesapeake Bay

By Steve Colman

A paper entitled "Anthropogenically Induced Changes in Sediment and Biogenic Silica Fluxes in Chesapeake Bay," written by **Steve Colman** and **John Bratton**, has been published in the journal *Geology* (January 2003). The paper, which addresses fundamental science questions related to reconstructing past environmental conditions, has many applied-science, ecosystem-management implications. It provides continuous, well-dated records of total-sediment and biogenic-silica fluxes from well before the arrival of Europeans to the present. Previous attempts to address these questions have been hampered by poor dating, short records that do not extend to presettlement times, or measurements that allow only concentration, rather than flux,

calculations. Owing to these problems, many studies of ecosystems and the geologic and biogeochemical processes that affect them fail to place their conclusions within a long-term context. The state of the system and its natural variability before its disturbance by human activity are critical for truly understanding the effects of humans on ecosystems.

Here is the paper's abstract: "Sediment cores as long as 20 m, dated by  $^{14}\text{C}$ ,  $^{210}\text{Pb}$ , and  $^{137}\text{Cs}$  methods and pollen stratigraphy, provide a history of diatom productivity and sediment accumulation rates in Chesapeake Bay. We calculated the flux of biogenic silica and total sediment for the past 1,500 years for two high-sedimentation-rate sites in the mesohaline section

of the bay. The data show that biogenic silica flux to sediments, an index of diatom productivity in the bay, as well as its variability, was relatively low before European settlement of the Chesapeake Bay watershed. In the succeeding 300-400 years, the flux of biogenic silica has increased by a factor of 4 to 5. Biogenic silica fluxes still appear to be increasing, despite recent nutrient-reduction efforts. The increase in diatom-produced biogenic silica has been partly masked (in concentration terms) by a similar increase in total-sediment flux. This history suggests the magnitude of anthropogenic disturbance of the estuary and indicates that significant changes had occurred long before the 20th century."✻

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